N92-10835

THE PHOTOMETRIC ROUGHNESS OF MIMAS

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Voyager imaging observations of Mimas lie between 6° and 132° in phase angle and provide sufficient data with which to model such surface characteristics as large-scale roughness and directional scattering properties. Multiple scattering dominates the photometric behavior of the bright icy surface of Mimas which has been shown to be moderately backscattering (Verbiscer *et al.* 1990). We have analyzed disk-integrated and disk-resolved Voyager clear filter photometric data using a modified version of Hapke's (1986) equation which accomodates anisotropic multiple scattering.

The disk-integrated data and solar phase curve are shown in the accompanying figure. The larger error associated with the observation at 6.2° results from corrections necessary to compensate for the excessive scattered light from the planet and its broad rings. Clearly, more observations at low phase angles are needed in order to characterize completely the opposition surge of the surface of Mimas. For our fitting purposes, we assume that the opposition surge of Mimas is similar to that of Rhea. The parameters which describe Rhea's opposition surge are angular width $h = 0.06$ and amplitude $B_o = 0.75$. From the phase curve we determine the geometric albedo of Mimas $p_v = 0.70 \pm 0.05$ and phase integral $q = 0.77 \pm 0.05$. These correspond to a spherical albedo $A = p_v q = 0.54 \pm 0.1$. Since the spectrum of Mimas is fairly flat (Buratti 1984), we can approximate the Bond albedo A_B with the spherical albedo.

Using the non-linear least squares algorithm developed by Helfenstein (1986) and described by Helfenstein *et al.* (1991) we simultaneously fit both full-disk observations, corrected for rotational albedo variations, and disk resolved data to the modified Hapke's equation. The fit is described by single scattering albedo $\tilde{\omega}_o = 0.961 \pm 0.003$, macroscopic roughness parameter $\bar{\theta} = 32° \pm 2°$, and Henyey-Greenstein asymmetry parameter $g = -0.19 \pm 0.01$.

The photometric roughness $\bar{\theta}$ is greater than that derived in similar manners from other bright icy satellite surfaces, though comparable to the 30° determined for Mimas by Buratti (1985) who applied the Hapke theory and the $30 \pm 25°$ found by McEwen (1987) who used fits to the Minnaert k parameter to determine $\bar{\theta}$.

This research was supported in part by NASA grants NGT 50482 and NSG 7156.

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Figure Caption:

Solar phase curve of Mimas based on Voyager clear filter data. Magnitudes are normalized to $-2.5 \log p$ at 0° where p is the geometric albedo at 0.48μm. Solid line is a fit to a modified version of Hapke's 1986 equation.